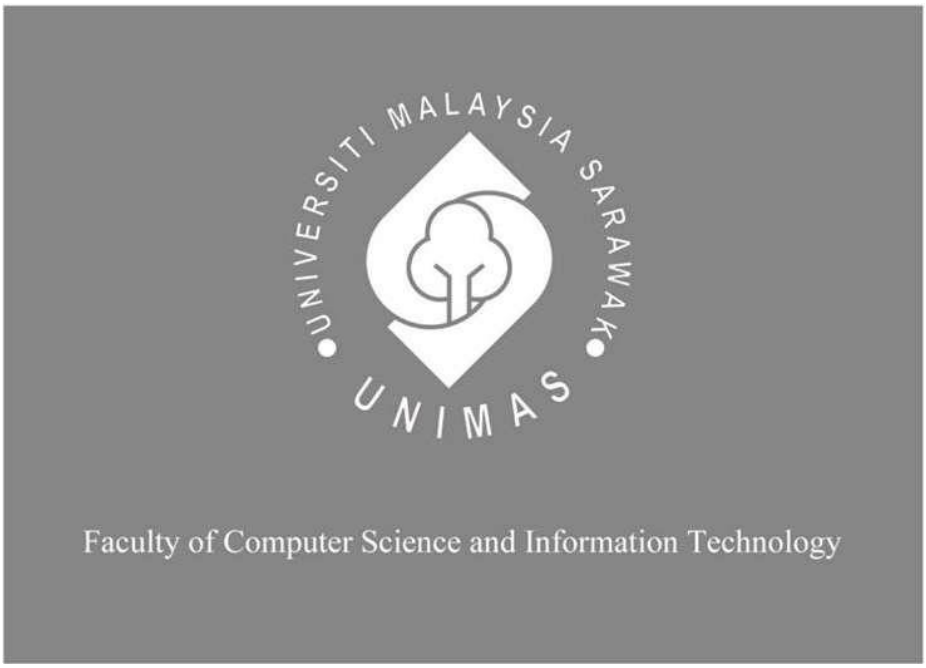

IoT Based Monitoring and Controlling Web System for Hydroponics Agriculture

Abu Sayed

Bachelor of Computer Science with Honors (Software Engineering)

2019

UNIVERSITI MALAYSIA SARAWAK

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Universiti Malaysia Sarawak

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Student's Name	_____Abu Sayed_____
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Student ID	_____59395_____
Program	_____Software Engineering_____

Has *done thesis correction according to the recommendation from Examiners and ready for final submission.*

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Universiti Malaysia Sarawak

Date 10/08/2020 *Signature & Official Stamp*

Examiner

Date

Signature & Official Stamp

Dr Mohamad Imran bin Hj Bandan
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Universiti Malaysia Sarawak

IOT BASED MONITORING AND CONTROLLING WEB SYSTEM FOR HYDROPONICS AGRICULTURE

ABU SAYED

This project is submitted in partial fulfilment of the
requirements for the degree of
Bachelor of Computer Science with Honors
(Software Engineering)

Faculty of Computer Science and Information Technology
UNIVERSITI MALAYSIA SARAWAK
2019

This Final Year Project Report entitled IoT Based Monitoring and Controlling Web System for Hydroponics Agriculture is submitted by **ABU SAYED** in partial fulfilment of the requirements for Bachelor of Computer Science (Hons.) Software Engineering, in Faculty of Computer Science & Information Technology, University Malaysia Sarawak which approved by

……..

Associate Professor Dr Hj Noor Alamshah bin Bolhassan

Supervisor

Faculty of Computer Science & Information Technology

Universiti Malaysia Sarawak

DECLARATION OF ORIGINALITY

I hereby declare that this research together with all its content is none other than that, my own work, with consideration of the exception of research-based information and relative materials that were adapted and extracted from other resources, which have evidently been quoted or stated respectively.

Signed by,

…….

ABU SAYED

Faculty of Computer Science and Information Technology

Universiti Malaysia Sarawak.

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The final year project is one of the scholarly prerequisites for the completion of my studies in Bachelor of Degree (Hons). Therefore, I might want to express my appreciation to UNIMAS and my faculty, Faculty of Computer Science and Information Technology for offering this course which has given me the chance to apply the information that I had learnt within my four years course.

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My sincere gratitude and appreciation also go to all my friends, and those whom have contribute immensely to the evolution of my project advancement.

ABSTRACT

Agriculture plays an important role in rural areas especially in developing countries to provide food production for a vast population. The use of IoT on agriculture is the new trend for IR 4.0 (Industrial Revolution 4.0). There are various ways to grow plant such as hydroponics system which is growing plants without the use of soil also known as a water-based solution. This thesis will propose an IoT based monitoring and controlling web system for hydroponics agriculture which will focus on setting up a server and design a web platform with the connection of IoT devices so that can control the devices through the web application.

ABSTRAK

Pertanian memainkan peranan penting di kawasan luar bandar terutamanya di negara-negara membangun untuk menyediakan pengeluaran makanan untuk penduduk yang ramai. Penggunaan IoT pada pertanian adalah trend baru untuk IR 4.0 (Industrial Revolution 4.0). Terdapat pelbagai cara untuk menanam tanaman seperti sistem hidroponik iaitu tumbuh-tumbuhan tanpa menggunakan tanah yang juga dikenali sebagai larutan berasaskan air. Tesis ini akan mengusulkan sistem web pemantauan dan pengawalan berasaskan IoT untuk pertanian hidroponik yang akan menumpukan pada penyediaan pelayan dan merancang platform web dengan sambungan peranti IoT sehingga dapat mengendalikan peranti melalui aplikasi web.

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CHAPTER 1: INTRODUCTION

1.1 Introduction

Agriculture is one of the important fields which plays an important role in rural areas. **IoT Based Monitoring and Controlling Web System for Hydroponics Agriculture** is a method of growing plants in a water-based, nutrient-rich solution without soil usages.

There are many ways to grow plants. Growing plants without soil are known as hydroponics. It might sound weird but many of the foods we eat are already grown hydroponically. Hydroponics does not use soil, instead, the root system using an intern medium such as perlite, rock wool, clay pellets, peat moss or vermiculite. The basic premise behind hydroponics is to allow the plant's roots to come in direct contact with the nutrient solution, while also having access to oxygen, which is essential for proper growth.

Despite the fact, hydroponics system will take a lot of time as well because of the monitor and balance the pH and nutrient levels on daily basis unless if it's managed by IoT technology. So, to overcome those issues an IoT based web system is greatly needed to monitor and control the hydroponics agriculture.

1.2 Problem Statement

There are various ways to grow plants like in traditional plants growing up by using soil and sunlight. For the growth of the plant, water is an important element. Mostly, the plant cannot grow properly due to lack of water as well as farmers are unable to check each of the plants as it is time-consuming and mankind's limitations. On the other hand, soil mostly not produced the expected result even the nutrition level is very low which also more time consumed and cost worthy for a startup entrepreneur, especially in Sarawak. Apart from that, the hydroponics system will be the best suit for Sarawak agriculture where everyone can start planting vegetables to produce their

daily nutrition. Currently, there are several technologies are used to monitor the plant most of the systems are automated. Besides that, some plants require less or more water than others such as vegetables and flowers. In that case, automated systems will provide the same amount of water level every time which will decrease plant growth. As a result, there are also some rumors surrounding our society regarding hydroponics agriculture.

1.3 Objectives

Objectives determine the key success of any kind of project. So, the major objectives of this project are:

- To set up a server using MySQL database for IoT based hydroponics system.
- To design and develop a web platform in order to monitor and control the IoT based hydroponics system in real-time.
- To evaluate the IoT based hydroponics system by testing with Arduino.

1.4 Methodology

The methodology that will be used for this project is the **Rapid Application Development methodology is known as RAD.**

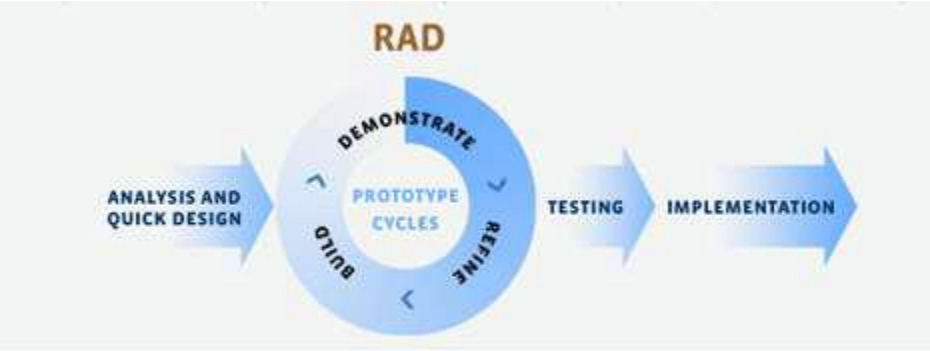

Figure 1. 1 Rapid Application Development Methodology Diagram (Amir, 2008)

In this project, the goal is to design and develop an IoT based web application within short time duration provided that will be able to function optimally. In order to develop a good quality web system, it is necessary to review and test the application several times before the real system is being deployed. This system is needed to go through a couple of developments, testing, and review process in order to ensure that the final system fulfills the requirements and objectives of the project. The first important thing is to have quick but well-defined goals and requirements before the process of developing the system.

It is also needed for data analyzing and early design of the application to get a rough idea at the early stage. As soon as the idea is there, it is time to start developing the system from the sketch. This includes the coding, user interface, application integration and much more. Application testing is the next phase which is a very crucial task to make sure that all the function of the system works how it is supposed to be. If it can run optimally, which means no crashes happened, every button works smoothly or no issue with the integration of hardware and software, no security issues then it is safe to be used. Other than that, it must be refined, develop and tested multiple times. After all, phases are through, that is when the deployment phase takes over. The above reason is why the most suitable methodology is Rapid Application Development (RAD).

1.5 Scope of Project

In this project, an IoT based web application will be developed that focuses on analyzing, monitoring and utilizing the data for hydroponics agriculture throughout a server which will store the record of retrieved data information provided by Arduino sensors. The application is specially designed to encourage youth community and those who do not have enough financial ability to have enough manpower for maintaining their agricultural farm which will be time savior. The users

will be able to control their farm in real-time from anywhere through the internet and can analyze the data daily which will help them to determine the performance of their farm and what action should be taken in further.

1.6 Significance of Project

There are several hydroponics systems or techniques available on the field whereby some of them are an almost similar process with comparing to this proposed system. However, there are still some procedures and methods provided the uniqueness to this proposed system. The significances of this system are:

- The existing systems does not have the Arduino features for retrieving data in real-time.
- The existing systems still need the person in charge of maintaining the farm manually. For example, check the pH level for the plants and so on.
- The existing systems not able to update the farm performance to the users which will harm or destroy the entire system.

1.7 Project Schedule

The timeline given by the faculty itself is as shown in the table below. For the Gantt chart please refer to the Appendix.

Table 1- 1 Project Schedule

Date	Agenda	Action By
29 September 2019	Submission of the Approved Brief Proposal	Student
19 October 2019	Submission of Final Full Proposal after Amendment	Student

26 October 2019	Submission of Chapter 1	Student
16 November 2019	Submission of Chapter 2	Student
5 December 2019	Submission of Chapter 3	Student
12 December 2019	Submission of FYP 1 Final Report & Paper for Assessment	Student & Supervisor
17-18 December 2019	Final Year Project Symposium	Student, Examiners & Supervisor
20 December 2019	Final Date for Examiners to Give their Comments & Feedbacks	Supervisor/ Examiners
8 January 2020	Final Date for Submission of Assessment Mark Through FYP management system (Online)	Student, Examiners & Supervisor
20 Dec-8 January 2020	Amendment and Modification Period for FYP (if any)	Supervisor/ Examiners
11 January 2020	Submission of Final Report (Softcopy) for FYP 1	Student
17 February 2020	Submission of the proposed/revised structure of FYP report, Title and Gantt chart (pdf format)	Student
21 March 2020	Submission of First Draft for Chapter 4	Student
6 April 2020	Submission of First Draft for Chapter 5 & Abstract for Paper	Student
5 July 2020	Submission of First Draft of FYP 2 Full Report & First Draft of Paper	Student

15 July 2020	Submission of Final Report for examination (word and Pdf Format), source code/scripts, installation kits, user manual and Paper for Assessment.	Student/Supervisor
21, 23 & 24 July 2020	Final Year Project Symposium (ONLINE)	Student, Examiners & Supervisor
21 July – 14 August 2020	Amendment and Modification Period for FYP (if any)	Student, Examiners & Supervisor
26 July 2020	Final Date for Examiners to give their comments & feedbacks (if any) to Project Supervisor	Supervisor/ Examiners
5 August 2020	Final Date for Submission of assessment mark through FYP Management System (Online)	Supervisor/ Examiners
15 August 2020	Submission of Final Report (Hard Cover & Softcopy), source code, report in word format, user guide, installation kits.	Student

The Estimated time for project development tasks as below:

Table 1- 2 Estimated Time for Project Development

Task Name	Estimated Duration (days)
1. Requirement Planning	14
1.1 Gather Requirements	8
1.2 Analysis Requirements	6
2. User Design	28
2.1 Develop detail area model	20
2.2 Develop outline of the system	8
3. Construction	81

3.1 Construct the System	30
3.2 Develop the Application	25
3.3 Connection Between the System and Application	20
3.4 System Documentation	6
4. Cutover	26
4.1 Install the System	12
4.2 Testing	14

1.8 Expected Outcome

This project will be able to produce real-time data monitoring and utilizing system for hydroponics agriculture from anywhere in the world while its fundamental structure is based on IoT techniques which will be user-friendly for everyone. Highly likely this system will be continuously upgradable to fulfill user satisfaction because of its methodology.

1.9 Project Outline

This project is divided into five (5) chapters:

Chapter one is regarding the introduction of the overview, problem statement, scope, objectives, significant of the project and the expected outcome once the project is completed.

Chapter two is the literature review. In this chapter, the researches for those systems that are already existed on the field will be highlighted, the comparison between existed systems and the proposed system which will be evaluated. Also, the discussion about the proposed system advantages over the existing ones will be done in chapter two.

Chapter three description of the methodology to develop the chosen project will be clarified. This chapter will explain the details of the design and development process needed in order to come up with a working web application.

In chapter four, the outcome of the project will be explained. Once the system is being developed, testing will take place. The result will be evaluated and explained in this chapter.

The summary of this project will be made in the last chapter also known as chapter five which includes the project findings and brief on future work.

1.10 Conclusion

Once again, Hydroponic is a method of growing plants in a water-based, nutrient-rich solution without soil usages. At the end of this project, users of the system will be able to keep track of the data from the IoT devices and take a decision for their farm in real-time through the Internet. It will eliminate their precious time by eliminating time consumption of hydroponic agricultural techniques.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

This chapter review three (3) existing systems based on research which are used on different platforms for monitoring and controlling the hydroponic systems using internet of things (IoT). The names of those systems are IoT hydroponics management system, Intelligent monitoring and controlling system for hydroponics precision agriculture and IoT based hydroponic system with supplementary LED light for smart home farming of lettuce.

Section 2.2 presents the background study of hydroponics systems followed by a section 2.3 where the review of the three existing systems is made. The overall summary of the existing system is presented and elaborated in section 2.4. In section 2.5 comparison and similarity are discussed between existing systems and the proposed system.

2.2 Background Study

Time is passing by the technology is getting better with it whereby peoples are relying on them to help in managing real-life events. Agriculture management systems are a major part of today's human resource systems. Current agriculture advancement is being challenged like never with sustainable food production and security in a demographically obese world as agriculture is undergoing industrialization, contemporary farming archetype demands advanced automated the system enabled by internet for communication [1]. There are several types of methods for the agriculture system, but the hydroponic culture method is best suited for every human being which an environmentally friendly technique of growing crops using essential nutrient elements without soil.

The aim of those systems is to make the monitoring and controlling process easier for users, reduce time consumption, eliminate the complexity of the process and provide well-executed hydroponics systems.

2.3 Review Existing System

There are multiple hydroponic systems designed with different operations and functionalities. In this section, three different hydroponic agriculture systems will be reviewed where each one of them has its own benefits and drawbacks.

2.3.1 IoT Hydroponics Management System

Figure 2. 1 System Management via Google Firebase (Jordan & Maravillas, 2018)

Hydroponics Management System (HMS) is a hydroponics system that enables users to control certain mechanisms for refilling, sprinkling, draining and many more through the web